Instructions

for use of the

ARISTO
Slide Rules

(Reitz Pattern)

Instructions for use of the ARISTO Slide Rules

Reitz Pattern

1. Purpose of the Slide Rule.

To-day a good Slide Rule is a highly appreciated instrument in all professional circles. Multiplications, divisions, the calculation of percentages, and similar problems, often very complicated, can be solved in an amazingly rapid and reliable manner.

The accuracy of the Slide Rule is absolutely sufficient for practical purposes. It depends on the length of the Slide Rule and is of the order of 0.1% with 30 cm Slide Rules.

Everyone using these instructions in which the various examples are demonstrated pictorially will soon appreciate the enormous advantages of the latest pattern Slide Rules and will recognize the splendid service which good Slide Rules can render. Daily practice will train the user in speed and accuracy.

When preparing the instructions we chose the actual Scales for the various illustrations. The illustrations therefore represent the actual face of the ARISTO Slide Rule and Students following the illustrations will find it a pleasing task to solve for themselves the examples given with the Slide Rule.

2. Description of the Slide Rule.

The Slide Rule consists of a body in which the Slide moves in the inside grooves and the cursor or indicator glides over the face in the outside guiding grooves.

A distinctive feature of the ARISTO Slide Rule is the new material from which it is manufactured entirely in one piece. The new material is not liable to warp or to shrink, which means that ARISTO Slide Rules retain their accuracy.

When the slide is pushed right into the body, we may read from top to bottom:

(1.) On the body — Cube Scale K		see figure 1
(2.) On the body — Square Scale A		
(3.) On the Slide — Square Scale B		
(4.) At the centre on the Slide — Reciprocal Scale C I or R		
(5.) On the Slide — Main Scale C		
(6.) On the body — Main Scale D		
(7.) On the body — Logarithmic scale L		

3. Reading the Scales.

The Slide Rule has no zero and, furthermore, does not tell us where to place the decimal point. The figure 1 at the start of the scales may represent 1, 10, 100, as well as 0.1, 0.01, &c. The same is true of all the divisions on the rule. Thus, the middle division between 2 and 3 is 2.5, which has also to be read as 0.25, 0.025, 25, 250, &c. For this reason, all readings taken from the Slide Rule must be considered for a certain group of figures without decimal point. The decimal point must be fixed by the operator himself.

In almost all practical problems the position of the decimal point is known, making voluminous rules for finding its position superfluous. In doubtful cases, rough calculations will soon show where the decimal point should be inserted. (See paragraph 6 — Combined multiplication and division.)

Numbers having more figures than are shown on the face of the Slide Rule are found between the divisions shown, estimating their positions by eye. For instance, 1255 is midway between 125 and 126. Should we require 1254, move the cursor to 1/10 th part, by eye, of the interval to the left of 1255. These settings are sufficiently accurate for all practical calculations. A similar procedure should be adopted when reading a result from the rule. For example, 558 is found where the hair line of the cursor is nearer 560 than 555 (see Fig. 1).

The sequence of readings on the illustrations is marked (1) (2) (3) (4)

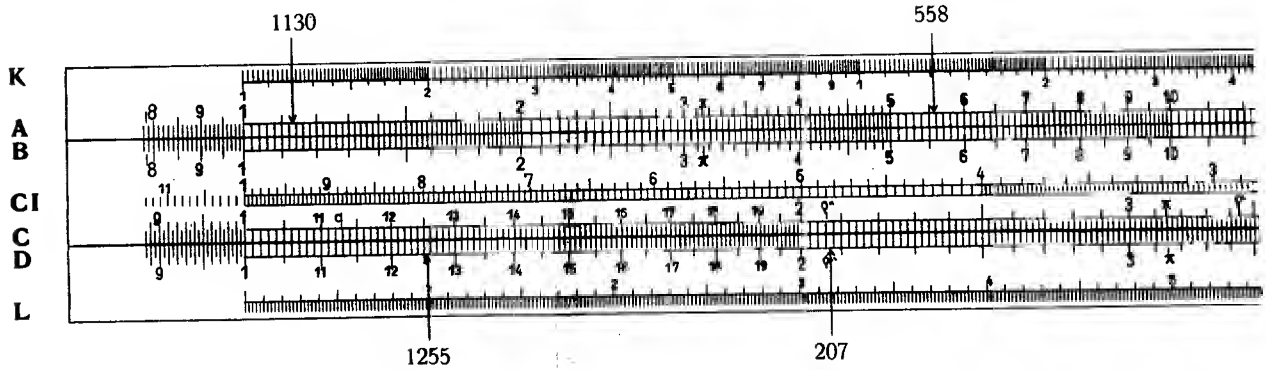


Fig. 1

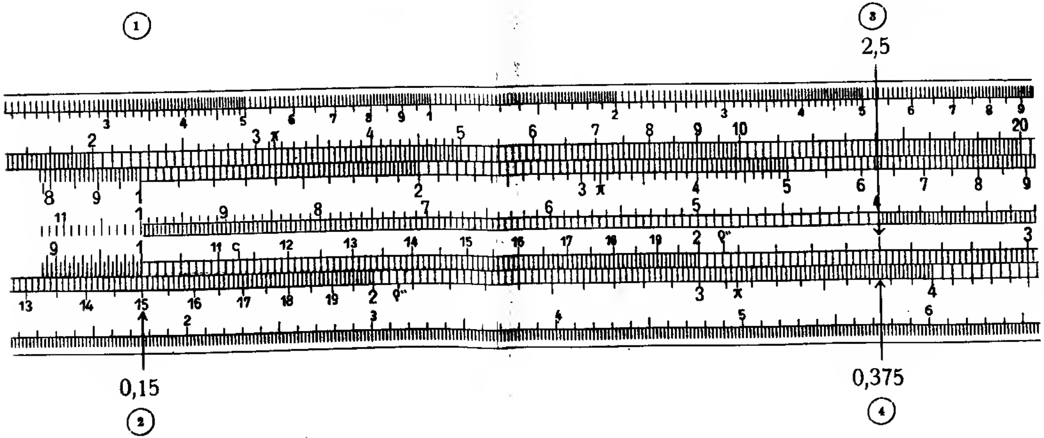


Fig. 2

Multiplication and Division can be carried out equally as well on the upper scales A and B as on the lower scales C and D. On the upper scales, the distance from 1 to 10 is equal to the distance from 10 to 100. The whole distance from 1 to 100 equals the length of the lower scales C and D which represent 1 to 10. Results obtained from scales C and D are therefore more nearly correct than those obtained from scales A and B. For this reason scales A and B are used especially to effect rough calculations, and also they may be used with advantage when problems are to be solved involving the multiplication of three or more numbers coupled with divisions.
For future reference we introduce the following names for the extreme lines of the scales:

number 1 on scale A	= A 1	number 1 on scale C	= C 1
„ 1 „ „ B	= B 1	„ 1 „ „ D	= D 1
„ 100 „ „ A	= A 100	„ 10 „ „ C	= C 10
„ 100 „ „ B	= B 100	„ 10 „ „ D	= D 10

The number 10 ending the left half of the squares scale in the middle of scales A and B will be denoted A 10 and B 10. The extended divisions in red found at both ends of the scales facilitates reading in some particular cases.
The Cube Scale K, the inverted Scale C I or R as well as the Logarithmic Scale L will be dealt with in separate paragraphs.

4. Multiplication.

The multiplication of two numbers is performed by adding their respective distances from the end of the slide rule body and slide. The "Distance" of a number is that section of the scale which begins at the left hand 1 (for instance — on scale D — at D 1) and ends at the line or estimated point where the required number is to be read.
The following examples have on the left the names of the scales employed and should, in general, be read from left to right and vertically within the sections.

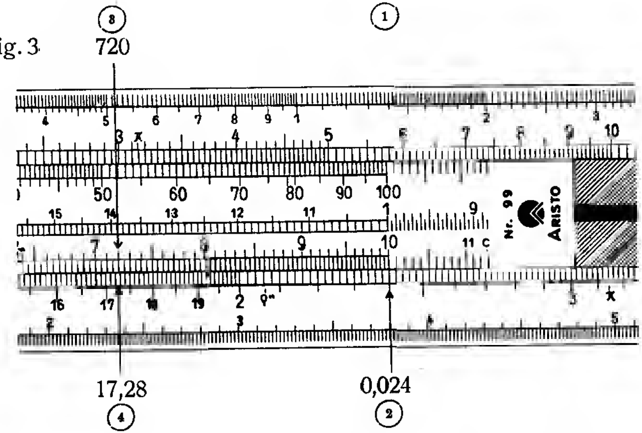
Example: $0.15 \times 2.5 = 0.375$ (Fig. 2)

Scale C	set C 1	under 25
Scale D	over 15	read 375 !

The result is 375. Where shall we place the decimal point? — at 0.375, 3.75 or 37.5? By rough calculation $0.1 \times 2 = 0.2$, we decide on 0.375.

Example: $0.024 \times 720 = 17.28$ (Fig. 3)

Fig. 3



In operating the Slide Rule to effect the above multiplication, by setting C 1 over 24 on scale D we notice that the second number (720) is not within the scales on the body of the Slide Rule. In this case it is necessary to set C 10 (on the right hand end of scale C on the slide) over the first number (24) on scale D.

Scale C	set C 10	under 72
Scale D	over 24	read 1728 !

Rough calculation: $2.4 \times 7.2 \approx 14$; consequently we conclude the result must be 17.28. We learn from this example that it does not matter at all which end of the slide is used for setting.

Multiplications of three or more numbers, e. g. $8.35 \times 18.7 \times 2.62 \times 14.8 = 6055$ may be carried out quite simply. By means of the cursor we mark the intermediate results, bring the C 1 line or C 10 line to coincide with the hair line of the cursor and proceed in this way until the final result is reached.

The sequence of the numbers to be multiplied together is of no importance as we multiply numbers by simply adding their respective distances on slide rule body and slide.

On becoming more acquainted with the Slide Rule you will soon detect that it is more practical to begin with the smaller number. Set small numbers on the scales of the slide rule body and larger numbers on the scales of the slide.

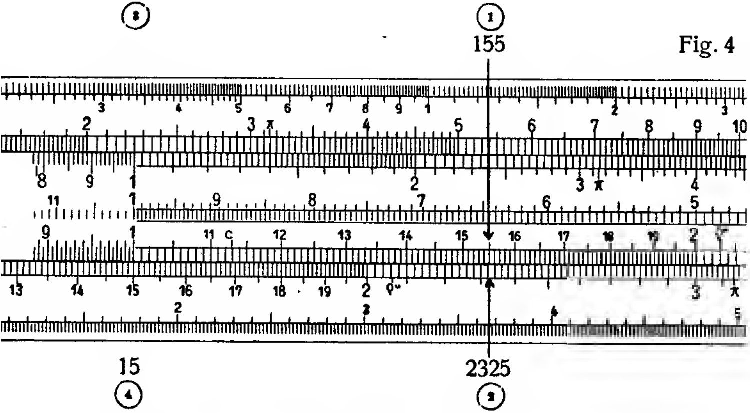


Fig. 4

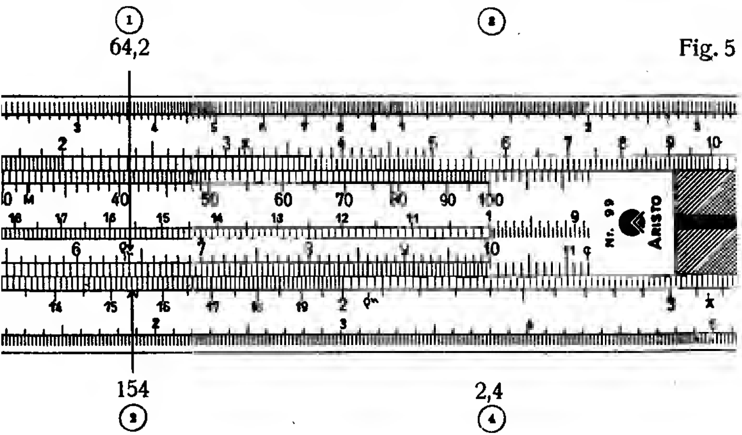


Fig. 5

5. Division.

The division of one number by another is performed by subtracting their respective distances on the Slide Rule body and slide from each other, i. e. the distance of the dividend is always to the lessened by the distance of the divisor. In other words division is the reverse operation of multiplication.

Examples: $2325 \div 155 = 15$ (Fig. 4)

Scale C	set 155	under C 1
Scale D	over 2325	read 15 !

Example: $154 \div 64.2 = 2.4$ (Fig. 5)

Scale C	set 642	under C 10
Scale D	over 154	read **24** !

Rough calculation: $150 \div 60 = 2.5$ hence the result can only be 2.4.

The result is thus found on scale D opposite C 1 or C 10 which, we will remember, are the names for the extreme lines on scale C.

6. Combined Multiplication and Division.

In problems involving both multiplication and division, we begin by performing the division; in which case, only one setting of the slide is necessary. We continue with the multiplication without reading the intermediate answer, which saves, in most cases, one setting of the slide. It may occur that on multiplying, it is impossible to read the result, as that section of the slide containing the required number projects beyond the slide rule body. We must proceed by marking the intermediate answer with the cursor. Then we bring C 10 to coincide with the hair line of the cursor. The final result can then be read in the usual manner on scale D.

When the problem contains three or more numbers to be multiplied or divided, it is advisable to start with a division, then to proceed with multiplications and divisions alternately.

In cases where multiplication and division are to be carried out and no great precision is required, we may use scales A and B

(see paragraph 3 — Reading the Scales). By using the A and B scales, for all calculations one setting of the slide will suffice; the result will always be within the scales on the body of the Slide Rule.

Employing the Inverted Scale C 1 — always coloured red on ARISTO Slide Rules — makes combined multiplication and division still easier.

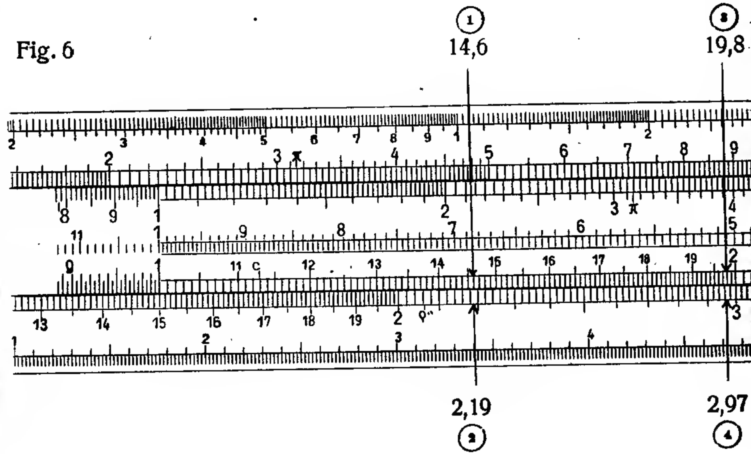
"Rule of Three" (or "Proportion") problems are solved expeditiously on the A and B scales.

Example: $\frac{2.19 \times 19.8}{14.6} = 2.97$ (Fig. 6)

Scale C	set 146	under 198
Scale D	over 219	read 297 !

Rough calculation: $2 \times 20 = 40$, $40 \div 14 \ \underline{\Omega}\ 3$; consequently 2.97.

Fig. 6



Example: $\frac{75 \times 144 \times 9 \times 35}{12 \times 25 \times 7 \times 36} = 45$ (C = Cursor)

Scale A	under 75							read 45 !
Scale B	set 12	C on 144	set 25 under C	C on 9	set 7 under C	C on 35	set 36 under C	over B 10

7. Calculation of Proportions.

For calculating proportions the Slide Rule is extremely convenient. All calculations connected with converting measurements, weights and currencies, as well as calculations of interest and discounts, can be solved at one setting of the slide by using scales A and B.

For calculations of this kind, the Slide Rule presents a complete Schedule of all the answers required. The C and D scales do not present such a complete Schedule at one setting, but the missing portion of the Schedule can be obtained by shifting the slide through its whole length, i. e. putting C 1 in the place of C 10 or vice versa.

If we consider the Gap between the slide and the body of the rule as being the stroke between numerator and denominator, we shall observe that all numbers opposite one another on slide and body bear the same relationship one to the other.

Example:

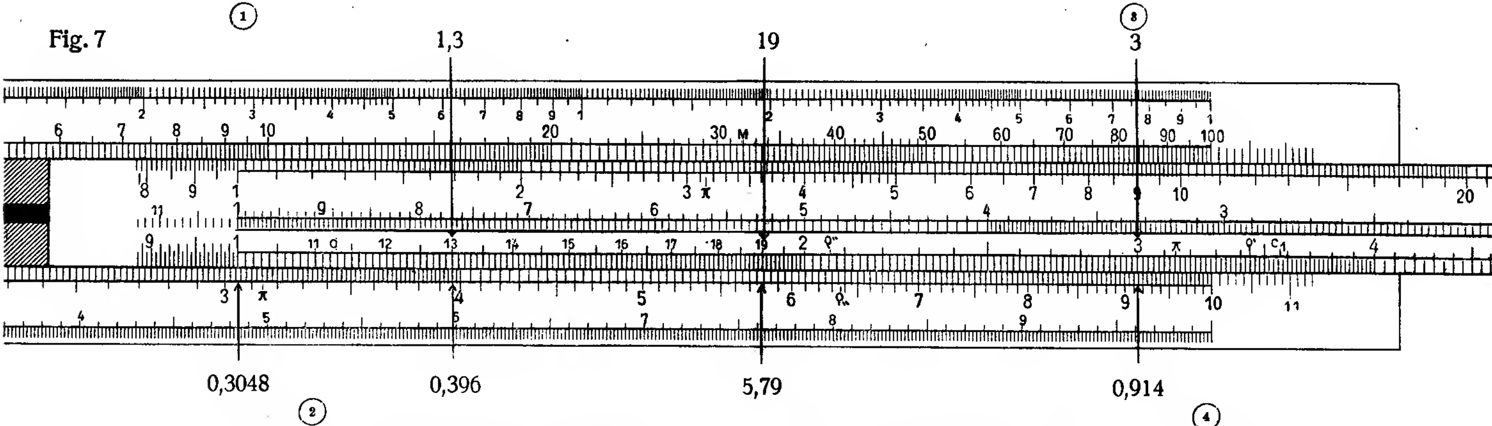
Scale A	set 2	$= \frac{4}{2} = \frac{6}{3} = \frac{8}{4} = \frac{10}{5}$ &c.
Scale B	over 1	

Example: Conversion of English feet into Metres and vice versa. (1 ft. = 0.3048 m.)

Scale C	set C 1	under 3 ft	under 1.3 ft	under 19 ft
Scale D	over 3048	read 0.914 m !	read 0.396 m !	read 5.79 m !

(Fig. 7)

Fig. 7

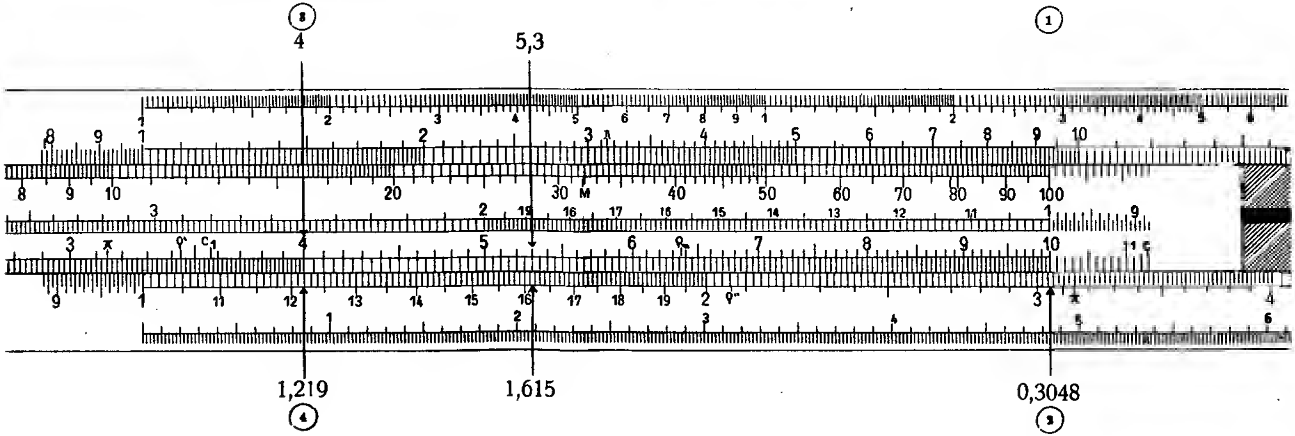


For converting Metres into feet set C 1 over 3048 and read over the number of Metres the equivalent in feet.

Scale C	set C 10	under 4 ft	under 5.3 ft	under 6 ft
Scale D	over 3048	read 1.219 m !	read 1.615 m !	read 1.828 m !

(Fig. 8)

Fig. 8

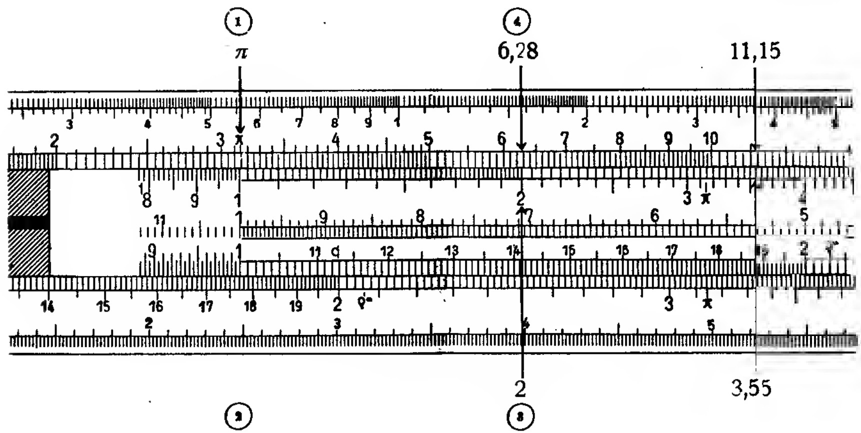


Example: Schedule for converting diameter of circle to circumference and vice versa. (Circumference = Diameter $\times \pi$) ($\pi = 3.14159$).

Scale A	under π	read 6.28 !	11.15	15.7	23.55
Scale B	set B 1	over 2	3.55	5.0	7.5

(Fig. 9)

Fig. 9



For finding the diameter from a given circumference the use of Gauge point M ($= \frac{1}{\pi}$) on scales A and B reduces the number of movements of the slide. Diameter d = circumference C $\div \pi$ = circumference $\times \frac{1}{\pi}$. Thus it requires only one setting of slide.

Scale A	under M	read 2 !	5.56
Scale B	set B 100	over 6.28	17.50

Example: Calculations of rate of exchange: The equivalent for 200 Lire is 26.18 Reichsmark. What is equivalent for 500 Lire, what for 1335 Lire.

Scale C	set 2	under 5	1335
Scale D	over 2618	read 6540 !	1748

Thus the equivalent for 500 Lire is 65.40, for 1335 Lire is 174.80 Reichsmarks.

Example: To determine the speed in metres/sec. or Kilometres/hour from given distances and times taken (km/h = 3.6 $\times$ m/sec).

Scale A	under 3.6	read 54 km/h !
Scale B	set B 1	(force of wind = **15 m/sec**)

8. Squares and Square Roots.

In order to make an interesting observation on the relationship of the main scales to the square scales, set the cursor to some number on the main body scale D, say, for instance 3. You will see that the hair line of the cursor is precisely on 9 on the body square scale A. 9 is exactly 3×3 or 3^2 (Fig. 10). This relationship is true for all numbers on the scales of the Slide Rule. It is evident from this statement, that the square of every number on scale D may be read on scale A. This fact explains logically the special arrangement of the upper scale in relation to the lower scale; viz. — the upper scale ranges from 1 to 10 and 10 to 100 whereas the lower scale ranges from **1** to **10**.

Example:

Scale A	read 144 !	6.25	961	3025	5110
Scale D	over 12	2.5	31	55	71.5

To read square roots we proceed in reverse order:

Example: $\sqrt{6.25} = 2.5$ (Fig. 10)

Attention must be paid to the fact that the number 625 appears twice on scale A, once on the left and once on the right. Which shall we use? A rough calculation will help here: Setting the cursor on 625 on scale A (right hand end) we find on scale D 79 being shown by the cursor. But neither 7.9^2 nor 0.79^2 will give the value 6.25; 7.9^2 is rather 62.5, i. e. $\sqrt{62.5} = 7.9$. Consequently the result for $\sqrt{6.25}$ can only be read by using the **left hand half** of the scale A, where we find vertically under 625 on scale A, 2.5 on scale D.

Rule: To find the Square root of a number having an odd number of figures to the left of the decimal point, (5, 173, 1.77, 15700) use the left hand half of scale A. To find the square root of a number having an even number of figures to the left of the decimal point (64, 24.76, 1765) use the right hand half of scale A.

Example:

Scale A	under 5	173	1.77	15700	64	24.76	1765
Scale D	read 2.236 !	13.14	1.33	125.1	8	4.97	42

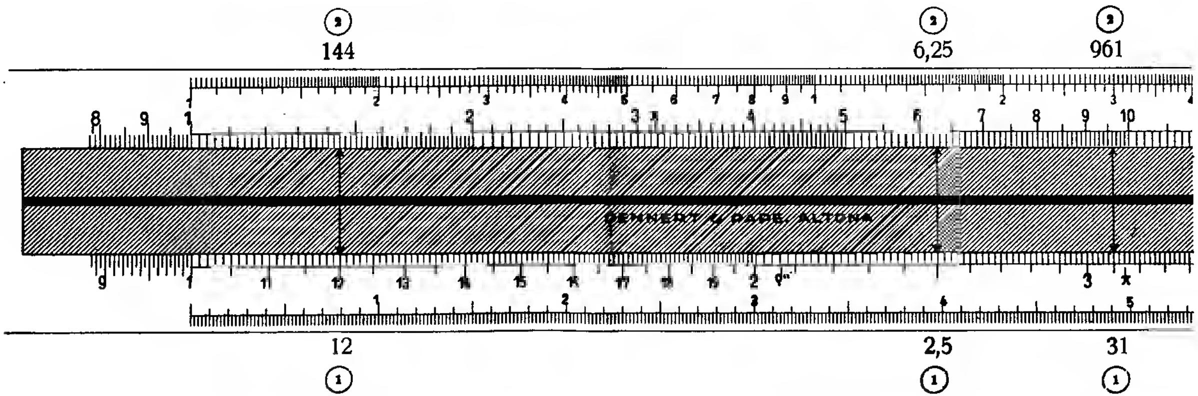


Fig. 10

9. Calculations with squares and square roots.

To calculate the area of a circle:

Let a = area, d = diameter, then area $a = \frac{\pi}{4} \times d^2$

$\pi = 3.14159$ and is marked on the A B C D scales.

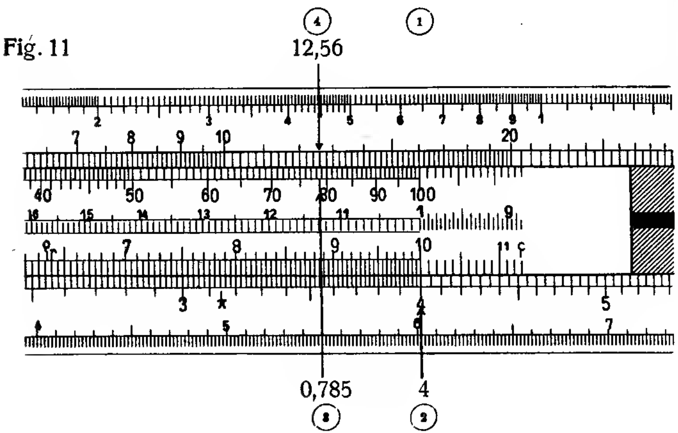
$\frac{\pi}{4} = 0.7854$ is marked in the right hand end of scales A and B and also in the corresponding red extension scales at the left of scales A and B.

Example: Calculate the area of a circle of diameter 4 cm. (Radius = 2 cm)

$a = \frac{\pi}{4} d^2 = 12.56 \text{ cm}^2$ (Fig. 11)

Scale A		read 1256 !
Scale B	set B 100	over 785
Scale C		
Scale D	on 4	

Fig. 11



Advantage may be taken of markings c and c_1 which are on scale C.

The explanation is: $c = \sqrt{\frac{4}{\pi}} = 1.128$ and $c_1 = \sqrt{\frac{40}{\pi}} = 3.57$.

Scale A		read 1256 !
Scale B		over B 10
Scale C	set c_1	
Scale D	over 4	

or

Scale A		read 1256 !
Scale B		over B 1
Scale C	set c	
Scale D	over 4	

It is advisable to use that one of the two gauge points c or c_1 which keeps as much of the slide as possible within the body of the Slide Rule.

(c is also marked in the red extension scale at the right of scale C.)

It is possible to extend such calculations to include a multiplication without further setting of the slide.

Example: The volume of a cylinder is given by

$$V = \frac{\pi}{4} \times d^2 \times h$$

Where V = volume, d = diameter, h = height.

The area of the cross-section of the cylinder $= \frac{\pi}{4} d^2$, so by proceeding as before:

Scale A		read 1256 !
Scale B		over B 1
Scale C	set c	
Scale D	over 4	

Then, with this setting of the slide, we have opposite any value of height on scale B, the volume of the cylinder.

for instance,

Scale A	read V = 25.2 !	100.8
Scale B	over h = 2	8

To use the three line Cursor.

The distance between the left hand hair line and the middle line, and also the distance between the right hand hair line and the middle line is equal to $\frac{\pi}{4} = 0.7854$. Consequently we may set the middle hair line on the number representing the diameter of the circle on scale D and under the left hand line on scale A we find the area of the circle without any setting of the slide.

In other words we effect the multiplication $d^2 \times \frac{\pi}{4}$ in simplified manner.

By reversing this order of working we may find the diameter of a circle from a given area.

10. Calculations with Cubes and Cube roots.

Triple multiplication of a figure for instance $3 \times 3 \times 3$ results in their 3rd power or Cube. Set the hairline of the cursor on figure 3 in scale D and you will find their 3rd power under the hairline on scale K, in this case 27.

Whilst the square scales A and B are arranged in two equal sections viz. 1—10 and 10—100 the Cube scale K has three equal sections i. e.

on the left	1 — 10	(K 1 — K 10)
in the middle	10 — 100	(K 10 — K 100)
on the right	100 — 1000	(K 100 — K 1000)

(For the sake of greater clarity sections are numbered 1—9 only thus zeros are omitted.)

Each equal section from 1 to 10 on scale K occupies exactly the third part of scale D graduated and numbered from 1 to 10, therefore scale K gives the Cube of any number on scale D.

Example: (Fig. 12)

Scale K	read 1.73 !	9261	15.62
Scale D	over 1.2	21	2.5

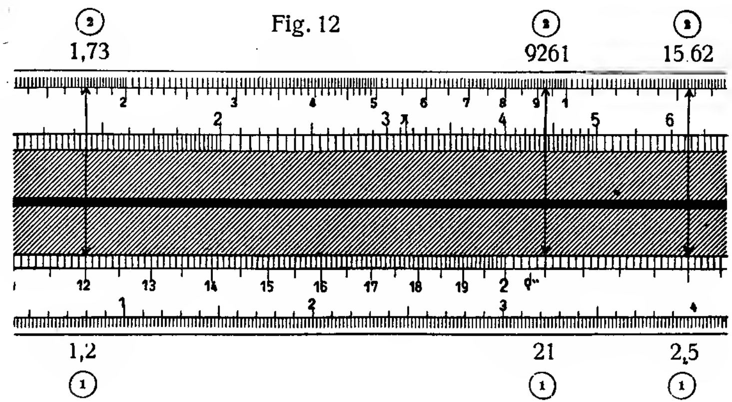
Where a higher degree of accuracy is required square scale A or logarithmic scale L may be used with advantage.

In the same direct manner the Cube root of any number in scale K may be read on scale D, but it must be taken into account that scale K has three equal sections.

Example:

Scale K	under 9.5	19.5	316
Scale D	read 2.118	2.695	6.81

Fig. 12



There is no difficulty in extracting the Cube root of figures from 1 to 1000 (see also examples) as the Cube scale K represents all the numbers within the range 1 to 1000. But, with numbers under 1 and numbers over 1000 the following procedure must be adopted. Divide the respective number into one number within the range 1 to 1000 and into the Cube number 1000 (10^3), now we extract the cube root of each number and obtain the final result by simple multiplication.

Example:

$$\sqrt[3]{2700} = \sqrt[3]{1000} \times \sqrt[3]{2.7} = 10 \times \sqrt[3]{2.7} = 10 \times 1.39 = 13.9$$

$$\sqrt[3]{27000} = \sqrt[3]{1000} \times \sqrt[3]{27} = 10 \times \sqrt[3]{27} = 10 \times 3 = 30$$

$$\sqrt[3]{270000} = \sqrt[3]{1000} \times \sqrt[3]{270} = 10 \times \sqrt[3]{270} = 10 \times 6.46 = 64.6$$

For finding the third power the same procedure is advisable.

Example:

$16.3^3 = (10 \times 1.63)^3 = 10^3 \times 1.63^3 = 1000 \times 4.32 = 4320$

Powers having fractional exponents may also be figured out on scale K, for instance set the Cursor Line on 7.5 on scale A and you will read on K $7.5^{3/2} = \sqrt{7.5^3} = 20.55$.

In the reverse order we can also solve the following problem

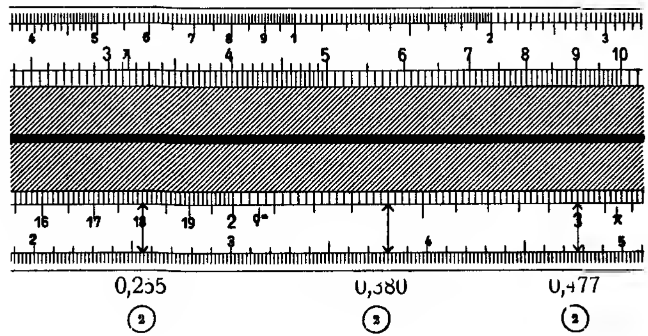
$7.5^{2/3} = \sqrt[3]{7.5^2} = 3.83$ by setting the Cursor Line on 7.5 on scale K and reading the result on scale A.

For further application of the Cube scale for whole and fractional exponents refer to mathematical manuals.

11. Logarithms.

The scale of equal parts L shows the logarithms. Readings may be taken by means of the cursor line. Bring the cursor line over 4 in scale D and read the logarithm of the number 4 on scale L viz. 602.

Fig. 13



Example:	Scale D	under 3	13	180	90	240
(Fig. 13)	Scale L	read 0.477	0.114	0.255	0.954	0.380

The scale L gives only the Mantissa of the logarithm, and the Characteristic must be added in the usual way.

Conversely, the number for any logarithm may be found by setting the Mantissa of the logarithm under the hair line of the Cursor and reading the number indicated by the hairline on scale D. The decimal point must then be inserted in the usual way.

Using scale L we may solve easily problems which involve exponents greater than 3.

Example: 2.57^5 = antilog. (5 × log. 2.57.) = 112.2.

Log 2.57 = 0.410. Now multiply, on scales C and D 0.410 by 5 = 2.050. Set the Mantissa .050 under the hair line of the Cursor, and read 1122 on scale D. The characteristic 2 locates the decimal point giving the answer 112.2.

Example: $\sqrt[6]{5200}$ = antilog. (log 2500 ÷ 6) = 4.16.

Log. 5200 = 3.716; 3.716 ÷ 6 = 0.619; antilog. 0.619 = 4.16.

12. Trigonometrical calculations.

On reverse of the slide there are three trigonometrical scales, above the sine scale (S), in the middle Sine and Tangent scale (S & T) for small angles, and below, tangent scale (T).

On using these scales we proceed as follows:- Set the angle on the trigonometrical scale under the hairline of the window fixed at the right hand of the slide rule body and read the corresponding value opposite D 10 in scale C. The Sine values of the upper scale S (sin $5^0 44'$ — 90^0) begin with 0, ... , the sine values of the middle scales (S & T) (sin $0^0 34'$ — $5^0 43'$) begin with 0,0 . . . . The scale S & T is also used for tang. values, however, the angles from $3^0 30'$ to $5^0 43'$ are to be corrected by adding 3%. Under $3^0 30'$ tangent may be taken equal to sine. All tangent values on the lower T scale (tang $5^0 44'$ — 45^0) begin with 0, ...

Examples: sine $4^0 50' = 0.0843$ (figs. 14 a and 14 b)
tang. $4^0 50' = 0.0843 + 3\,^0/_{00} = 0.0845$
sine $2^0 20' = 0.0407$ (= tang. $2^0 20'$)
sine $19^0 10' = 0.3283$ (figs. 15 a and 15 b)
tang. $31^0 10' = 0.605$ (figs. 16 a and 16 b)

The value of the cosine of an angle may be obtained from the sine scale as for instance cos $70^0 50' = \sin (90^0 - 70^0 50')$ = sine $19^0 10' = 0.3283$.

For angles exceeding **45^0**, we may find the value of the tangent by the following method:

$$\text{Tang}\ \alpha = \frac{1}{\text{tang}\ (90^0 - \alpha)} = \text{cotang}\ (90^0 - \alpha)$$

Example: $\text{Tang}\ 58^0 50' = \dfrac{1}{\text{tang}\ 31^0 10'} = \text{cotang}\ \mathbf{31^0 10'}$

Set $31^0 10'$ on T scale to the hair line. Turn the slide rule over, and opposite C 1 read 1.653 on D.

$$1.653 = \frac{1}{0.605}$$

For small angles (under 35') for all practical purposes sine = tangent = arc. To find these values, gauge points ϱ' and ϱ'' on scales C and D are used.

For an angle in minutes use ϱ' and for an angle in seconds use ϱ''.

Example: Sine $0^0 15' \;\underline{\Omega}\;$ tang $\mathbf{0^0 15} \;\underline{\Omega}\;$ arc $0^0 15' = \mathbf{0.00436}$.

Scale C	set ϱ'	under C 10
Scale D	over 15	read 436 !

Example: Sine $0^0 0' 20'' \;\underline{\Omega}\; 0^0 0' 20'' \;\underline{\Omega}\;$ arc $0^0 0' 20''$ = 0.0000971.

Scale C	set ϱ''	under C 10
Scale D	over 20	read 971 !

On computing with the 400^0 trigonometrical system (100^0 each quarter) the procedure on applying the mark $\varrho_{,,}$ is the same. It does not matter whether the problem deals with centiminutes or centiseconds, only the decimal point is thereby affected.

Examples: sine $0.15^0 \;\underline{\Omega}\;$ tang $0.15^0 \;\underline{\Omega}\;$ arc 0.15^0 = 0.00236
sine $0.0020^0 \;\underline{\Omega}\;$ tang $0.0020^0 \;\underline{\Omega}\;$ arc 0.0020^0 = 0.0000314

For trigonometrical problems requiring a number of sines and tangents at once, remove the slide from the body of the Slide Rule and invert it, sliding it back in the Slide Rule body with scale S alongside scale A and scale T alongside scale D. Take care that the extreme lines of the scales coincide exactly with A 1, A 100, D 1 and D 10.

We have now a complete set of values of sines and tangents at our disposal.

Under each angle on the S, S & T and T scale we have the corresponding values on scale D.

Fig. 14 a ① 4° 50′

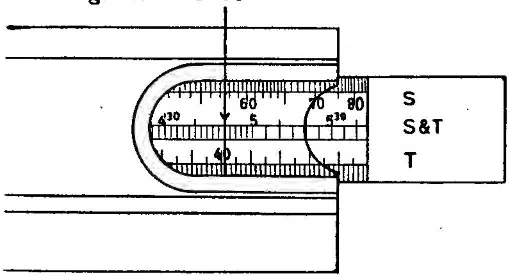


Fig. 15 a ① 19° 10′

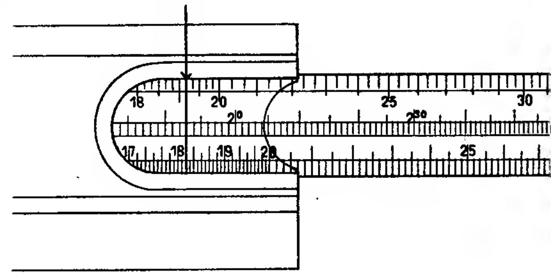


Fig. 14 b ② 0,0843

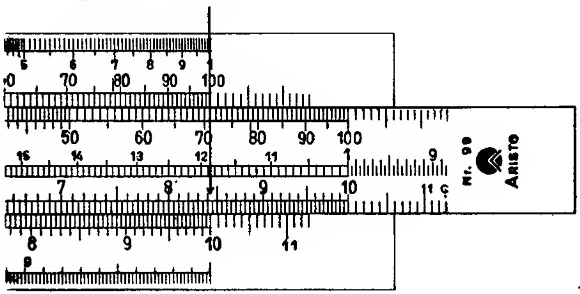


Fig. 15 b ② 0,3283

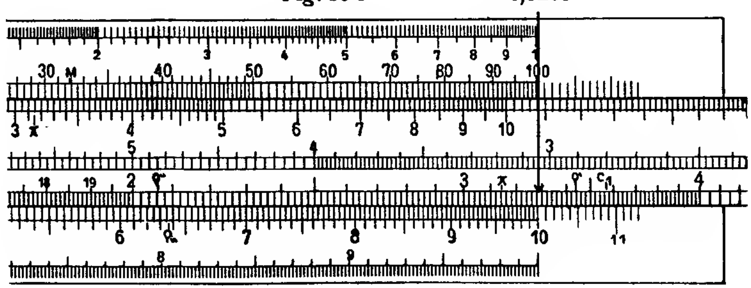
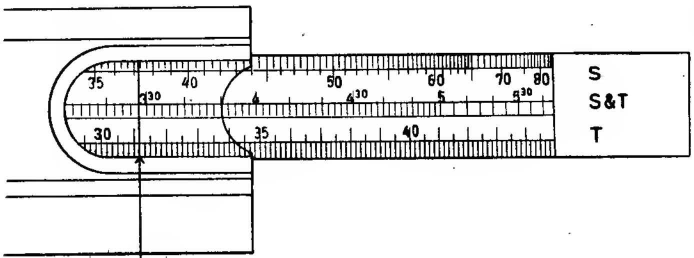


Fig. 16 a



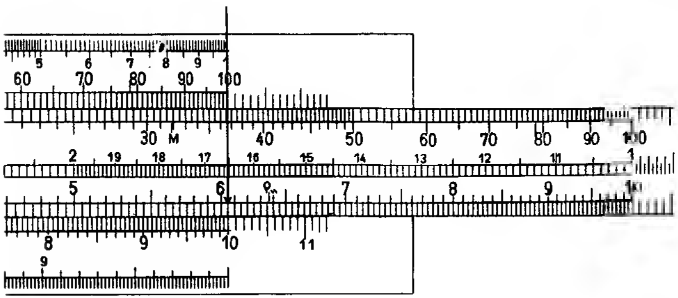
31° 10′

1

Fig. 16 b

2

0,605



13. Gauge Points.

	$\pi = 3.14159$	(on scales A, B, C, D.)
	$\frac{\pi}{4} = 0.7854$	(on scales A and B to the right, and also on the red extension scale on the left)
$M =$	$\frac{1}{\pi} = 0.318$	(on scales A and B to the right)
$c =$	$\sqrt{\frac{4}{\pi}} = 1.128$	(on scale C and on the red extension scale on the right)
$c_1 =$	$\sqrt{\frac{40}{\pi}} = 3.57$	(on scale C)

$\varrho' = \text{sine}\,0^\circ 1'$ ≙ tang $0^\circ 1'$ ≙ arc. $0^\circ 1' = 0.000291$

(on scale C between 3,4 and 3,5)

$\varrho'' = \text{sine}\,0^\circ 0' 1''$ ≙ tang $0^\circ 0' 1''$ ≙ arc. $0^\circ 0' 1'' = 0.0000048$

(on scales C and D between 2,0 and 2,1)

$\varrho_{,,} = \text{sine}\,0{,}01^\circ$ ≙ tang 0.01° ≙ arc. $0.01^\circ = 0.000157$

(on scales C and D between 6,3 and 6,4)

14. Reciprocal or Inverse scale.

The Reciprocal scale (subsequently referred to as scale R) is placed in the middle of the Slide, and is divided exactly as scales C and D, but starting at the opposite end. Thus R 1 is opposite C 10, and R 10 is opposite C 1. On ARISTO slide rules the scale R is always coloured red.

To find the reciprocal of a number $n = \frac{1}{n}$, we set the cursor to **n** on scale C and read its reciprocal above on scale R. We may also proceed in reverse order. Thus we need not move the slide but only the cursor. When the slide is pushed into the body so that the graduations on scales C and D coincide, reciprocals may, of course, be projected from scale D to scale R.

Example: In scale C: $n = 4$ read in scale R, $1 \div 4 = 0.25$.

In the same easy manner we may find:

$1 \div n^2$ Cursor on n in R, read in A or B:

$1 \div 4^2 = \frac{1}{16} = 0.0625$ or vice versa

$1 \div \sqrt{n}$ Cursor on n in scale A, read on scale R:

$1 \div \sqrt{4} = ½ = 0.5$

furthermore:-

$1 \div n^3$ Cursor on n on scale R, read in scale K:

$1 \div 4^3 = \frac{1}{64} = 0.0156$ or vice versa.

$1 \div \sqrt[3]{n}$ Cursor on **n** in scale K, read on scale R:

$1 \div \sqrt[3]{4} = \frac{1}{1.587} = 0.63$

The multiplication and division of three or more numbers is remarkably simplified by the reciprocal scale.

When multiplying three numbers together, using scale R in conjunction with scales C and D renders one setting of the slide sufficient in most cases. This use of the scale R is of enormous value as less settings of the slide save much time and result in greater accuracy.

Example: $0.16 \times 40 \times 5.5 = 35.2$ (Fig. 17)

Scale R	set 16	
Scale C		under 55
Scale D	over 4	read 352 !

Rough calculation: $0.1 \times 40 \times 5 = 20$, thus answer is more than $20 = 35.2$.

By similar use of the slide rule, problems of division may be solved.

Example: $\frac{33.3}{50 \times 1.28} = 0.52$ (Fig. 18)

Scale R	set 128	
Scale C		read 52 !
Scale D	over 50	over 333

Rough calculation: $\frac{30}{50 \times 1.2} = 0.5$. Thus answer is 0.52.

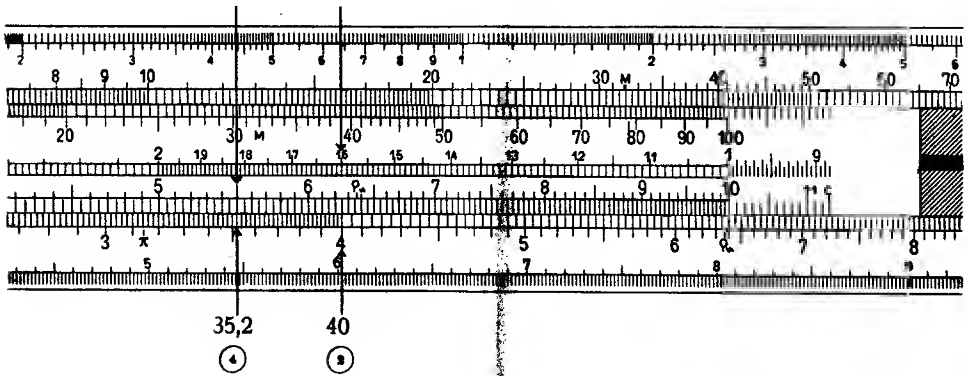


Fig. 17

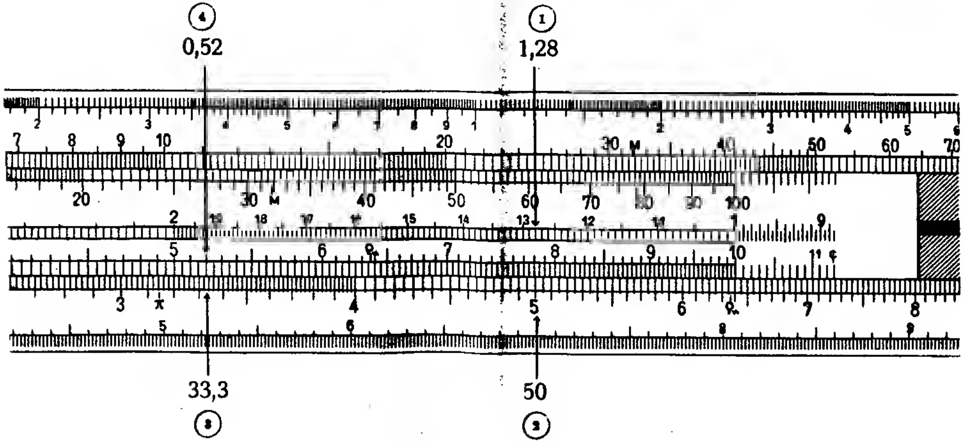


Fig. 18

Notes.

We have been engaged in the Art of Slide Rule manufacture since 1873 and are the oldest Makers of Slide Rules in Germany.

Our range of production comprises a large number of Special purpose Slide Rules suitable for Electricians, Surveyors, Merchants, Accountants, Constructional Engineers, Mining Engineers, as well as Slide Rules for Testing Materials and Timekeeping etc: etc:

In our Slide Rule department we also manufacture scales, protractors, Course Rules, Set-squares &c. which are also offered under the ARISTO Brand warranting everlasting accuracy.